REMARKS

In the Office Action dated August 25, 2004, the Examiner has ***finally rejected*** claims 93-117 pending in the application on the basis of new grounds of rejection and newly cited art. Applicant respectfully requests reconsideration and withdrawal of the finality of the rejection of the Office Action dated August 25, 2004.

A good and sufficient reason why the present response is necessary and was not earlier presented is that an entirely new reference has been cited in the present final rejection dated August 25, 2004 (37 CFR §1.116 (c)). The new reference is U.S. Patent Number 6,017,814 to Grill, et al. ("Grill") which is for the first time brought to Applicant's attention by means of the present ***final rejection*** dated August 25, 2004. The new reference, i.e., Grill, was not cited in the present application prior to the instant final rejection. Since Grill is a reference upon which the Examiner has now relied, Applicant believes that it would be manifestly unfair for the Patent Office not to consider Applicant's arguments which are necessitated due to the newly cited reference, Grill. As such, a good and sufficient reason exists, as required by 37 CFR §1.116(c), for considering Applicant's present response and withdrawing the finality of the present Office Action.

A. Rejections of Claims 93-117 under 35 USC §103(a)

The Examiner has rejected claims 93-117 under 35 USC §103(a) as being obvious with respect to U.S. Patent Number 5,792,706 to Michael, et al. ("Michael"), U.S. Patent

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Number 6,040,248 to Chen, et al. ("Chen"), and U.S. Patent Number 6,017,814 to Grill, et al. ("Grill"). For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by independent claims 93 and 105, is patentably distinguishable over Michael, Chen, and Grill.

Embodiments according to the present invention, as defined by amended independent claims 93 and 105, teach forming a first air gap, a second air gap, and a support pillar in a first hard mask, a second insulating layer (claim 105), and a first insulating layer, where the support pillar is situated between the first and second air gaps, where the first and second air gaps are situated in a trench in a direction parallel to a length of the first interconnect line. The support pillar is in contact with the first interconnect line, and the support pillar is formed to increase mechanical strength and thermal conductivity of the first interconnect line. An interconnect can be provided having multiple air gaps between interconnect lines in various directions, such as both in a first direction, i.e. generally parallel to a first interconnect line, and in a second direction, i.e. generally perpendicular to the first interconnect line.

A support pillar is situated between air gaps formed in a hard mask, where the support pillar and air gaps can have any shape, and where the support pillar is in contact with a first interconnect line. By appropriately controlling the size and shape of the first and second air gaps formed in the hard mask, the size and shape of the support pillar formed between the first and second air gaps in the first insulating layer can be advantageously controlled to achieve a desired increase in the mechanical strength and

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thermal conductivity of the first interconnect line. As a result, embodiments according to the present invention advantageously achieve a flexible interconnect structure that includes first and second air gaps to provide reduced inter-layer and/or intra-layer parasitic capacitance and a support pillar having an appropriate size and shape to increase the mechanical strength and thermal conductivity of an interconnect line in contact with the support pillar.

In contrast, Michael does not disclose, teach, or even suggest forming a first air gap, a second air gap, and a support pillar in a first hard mask, a second insulating layer (claim 105), and a first insulating layer, where the support pillar is situated between the first and second air gaps, where the first and second air gaps are situated in a trench in a direction parallel to a length of the first interconnect line, where the support pillar is in contact with the first interconnect line, and wherein the support pillar is formed to increase mechanical strength and thermal conductivity of said first interconnect line. Michael teaches forming air gap trenches 26 in first dielectric 20, where air gap trenches 26 extend between first interconnect lines 11. See, for example, column 6, lines 33-38 and Figure 6 of Michael. In Michael, trenches 26 are placed indiscriminately with respect to first interconnect lines 11. See, for example, lines 39-41 and Figures 6 and 7 of Michael.

Nevertheless, Michael fails to disclose, teach, or suggest forming a support pillar between air gap trenches 26, where the support pillar is in contact with an interconnect line, and where the support pillar is formed to increase the mechanical strength and

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thermal conductivity of the interconnect line. Furthermore, Michael does not even suggest or mention forming a support pillar or similar structure between air gaps to increase the mechanical strength and thermal conductivity of an interconnect line.

Furthermore, by placing air gap trenches 26 indiscriminately with respect to first interconnect lines 11, Michael actually teaches away from forming a support pillar between adjacent air gap trenches, where the support pillar is in contact with an interconnect line and is provided to increase the mechanical strength and thermal conductivity of the interconnect line. Also, Michael fails to teach, disclose, or suggest a support pillar formed between air gaps, where the air gaps and support pillar are situated in a trench in a direction parallel to a length of an interconnect line.

Chen does not cure the deficiencies of Michael. In contrast to the present invention as defined by independent claims 93 and 105, Chen does not disclose, teach, or suggest forming a first air gap, a second air gap, and a support pillar in a first hard mask, a second insulating layer (claim 105), and a first insulating layer, where the support pillar is situated between the first and second air gaps, where the first and second air gaps are situated in a trench in a direction parallel to a length of said first interconnect line, where the support pillar is in contact with the first interconnect line, and wherein said support pillar is formed to increase mechanical strength and thermal conductivity of said first interconnect line. The Examiner asserts that Chen discloses a silicon oxide hard mask, which is utilized to etch a contact opening in an organic layer. However, the addition of Chen fails to overcome the deficiencies of Michael discussed herein.

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Chen does not disclose, teach, or suggest the elements of independent claims 93 and 105. Furthermore, there is no teaching or suggestion to combine or modify Chen. Therefore, Chen, singly or in combination with other art of record, does not disclose, teach, or suggest the present invention as defined by independent claims 93 and 105.

Furthermore, Grill does not cure the deficiencies of Michael and Chen. Grill merely teaches a structured dielectric layer and fabrication process for separating wiring levels and wires within a level on a semiconductor chip. A lower dielectric layer has narrow air gaps to form dielectric pillars or lines. An upper dielectric layer is formed over the pillars or fine lines. The air gaps function to reduce the effective dielectric constant of the structured layer.

In contrast to independent claims 93 and 105, Grill does not disclose, teach, or suggest, for example, depositing a sealing layer over a first hard mask to seal a first air gap and a second air gap. Grill also does not disclose, teach, or suggest forming a support pillar to increase mechanical strength and thermal conductivity of a first interconnect line.

Grill does not disclose, teach, or suggest the configuration of amended claims 93 and 105. Furthermore, there is no teaching or suggestion to combine or modify Grill. Therefore, Grill, singly or in combination with other art of record, does not disclose, teach, or suggest the present invention as defined by independent claims 93 and 105.

Moreover, Applicant respectfully submits that the fact that the Examiner has deemed it necessary to combine as many as *three* references (as opposed to merely two

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references), is additional indication that the present invention was not obvious to one of ordinary skill in the art at the time it was invented.

For the foregoing reasons, Applicant respectfully submits that the present invention as defined by independent claims 93 and 105 is not taught, disclosed, or suggested by the art of record. Thus, independent claims 93 and 105 are patentably distinguishable over the art of record. As such, the claims depending from independent claims 93 and 105 are, *a fortiori*, also patentable for at least the reasons presented above and also for additional limitations contained in each dependent claim.

B. **Conclusion**

Based on the foregoing reasons, the present invention, as defined by independent claims 93 and 105, and the claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, outstanding claims 93-117 are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early Notice of Allowance directed to all claims 93-117 remaining in the present application is respectfully requested.

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